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Soil Survey

of

Neosho County, Kansas

By

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United States Department of Agriculture, in Charge
and
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Kansas Agricultural Experiment Station

Bureau of Chemistry and Soils

In cooperation with the
Kansas Agricultural Experiment Station

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SOIL SURVEY OF NEOSHO COUNTY, KANSAS

By M. H. LAYTON, United States Department of Agriculture, in Charge, and R. W. O'HARA and C. E. DORNBERGER, Kansas Agricultural Experiment Station

COUNTY SURVEYED

Neosho County is in southeastern Kansas, in the second tier of counties from the eastern boundary of the State and in the corresponding tier from the southern boundary (fig. 1). Erie, the county seat, is located about 4 miles east of the center of the county. It is about 110 miles southwest of Kansas City and the same distance east of Wichita.

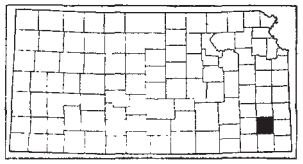

FIGURE 1.—Sketch map showing location of Neosho County, Kans.

The boundaries of the county form a rectangle about 24 miles square, enclosing a total area of 576 square miles, or 368,640 acres. The county is in the prairie plains section of southeastern Kansas. It is part of a plain of low relief, the product of long-time erosion on a series of sedimentary rocks, mainly shales, with thin beds of limestones and sandstones. Although the stage of topographic development is far advanced toward base level, the differences in resistance to erosion of the several kinds of rocks express themselves in differences of relief. Where the sandy shales predominate, the relief is very smooth and the valleys are broad; but where the creeks cross limestone beds which are more resistant to erosion, the valleys are narrow and the outcrops of these beds across the uplands express themselves in low ridges, many of which are escarped.

The range in elevation throughout the county is not great, and the average elevation is about 950 feet above sea level. The elevation [1] at Thayer is 1,047 feet; at Stark, 1,042 feet; at Chanute, 940 feet; at Erie, 896 feet; and at St. Paul, 886 feet. Chanute, Erie, and St. Paul are along Neosho River, and their elevations indicate the gradient of the river.

Surface drainage is generally good, and underdrainage, because of considerable areas of soils with heavy clay subsoils, is less perfect. Drainage is effected through Neosho River and its tributaries. These streams are sluggish, with meandering channels and a gradient of about 2 feet to the mile. Neosho River is a permanent stream, but the smaller streams flow intermittently during the summer, although the deeper pools seldom, if ever, are entirely dry. Neosho River empties into Arkansas River after leaving the State of Kansas.

The natural vegetation on the uplands consists almost entirely of grasses, little bluestem and big bluestem (Andropogons) being most

[1] GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U. S. Geol. Survey Bull. 274, Ed. 4, 1,072 pp. 1906.

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abundant, and broomsedge is abundant on the lighter soils. Other common grasses are Kentucky bluegrass, English bluegrass, switchgrass, Indian grass, prairie sedges, a number of wild legumes, such as prairieclover, vetch, hoary pea or catgut, and tumblingweed or wild alfalfa. In long-overgrazed pastures many kinds of grasses and weeds have come up, such as poverty grass, foxtail, some sideoats grama, and some water-loving sedges. The most common weeds are ragweed, goldenrod, pokeweed, rockweed, broomweed, wild onion, ironweed, false-indigo, buckbrush, dogweed, and daisies. On the heavier and moister soils, especially where the ground is shaded, English bluegrass is establishing itself. Shrubs and vines, such as butternut, wood vine, bittersweet, dogwood, wild grape, blackberry, willow, wild cherry, persimmon, and various species of sumac, of which the aromatic is the most abundant, grow on the steeper slopes. The alluvial lands were originally covered with trees and water-loving grasses. The trees included hackberry, ash, elm, pin oak, black oak, water oak, black walnut, hickory, cottonwood, almond willow, sycamore, post oak, hawthorn, maple, and papaw. In the southwestern part of the county small areas of land along the streams are covered almost entirely with scrub, post, red, and black oaks. On the slopes, where erosion has removed the surface soil down to the partly decomposed shales, needlegrass has come in to some extent, but a few small spots are nearly void of vegetation.

Under natural conditions the soils contain very good supplies of organic matter, as a result of the favorable conditions for the accumulation and preservation of humus. This statement applies principally to the better drained soils, as in the imperfectly drained soils the organic matter is seemingly lower, and the vegetation is not so abundant.

Neosho County was organized about 1864, but permanent settlement did not take place until about 1870. The territorial legislature of Kansas in 1858 created the county of Dorn, which was later divided into Labette and Neosho Counties. Osage Indians occupied this land, and settlement by the whites was begun about 1850. The early settlers were chiefly from States to the east, many coming from Indiana, Iowa, Illinois, Missouri, New York, Ohio, Pennsylvania, and Tennessee.

According to the Federal census, the population of the county is 22,665, of which 10,277 are classed as urban and 12,388 rural. Of the rural population 8,812 are classed as rural farm and 3,576 as rural nonfarm. The density of the rural population is 21.5 persons to the square mile. Erie, the county seat, has a population of 1,184. Chanute, in the northwestern corner, is the largest town, with a population of 10,277. Smaller towns are St. Paul, Thayer, Galesburg, Earleton, and Stark. A small part of the rural population in the southwestern part of the county is engaged in coal mining. The coal is mined largely for local use from shallow beds. Shallow gas and oil wells are numerous.

The county is served by 122 miles of main-track railways of the Missouri, Kansas & Texas and the Atchison, Topeka & Santa Fe systems. Most farms are within a short distance of shipping points, and sidetracks are numerous, from which shipments of agricultural products may be made without long country hauls. Motor-bus lines

also cross the county in several directions, operating on hard-surfaced, mainly graveled, highways, of which there are about 200 miles.

Practically no point is more than 6 miles from a graveled or paved road. Most of the county roads follow section lines. The dirt roads are maintained in only fair condition. On the upland, travel is seldom hindered by poor roads, but on the broad bottoms of Neosho River and the creeks, dirt roads are frequently in very bad condition, and in times of flood, even the main highways are blocked by high water. During the spring of 1929 many miles of surfaced roads were covered by water from flooded streams to such depths as to render them impassable.

Rural mail routes and telephone service reach all sections. The county is well supplied with churches of different denominations, and school facilities are ample. Each town or village has at least one good school, and more than 100 country schools are located at convenient points.

Many laborers are employed in industries other than agriculture, such as grain elevators, creameries, wholesale houses, cement plants, brickyards, broom factories, bottling works, gas-mantle factories, drilling-tool and supply plants, garden-tractor plants, coal mines, gas wells, and oil wells.

Surplus farm products, including grain, hay, livestock, dairy products, and poultry products, are marketed by local dealers. Much of the wheat and hay is shipped to Kansas City, the greater part of the grain is handled in local elevators, and many dairy and poultry products are trucked to Kansas City. Fruits and vegetables are grown for local markets, and many hundred crates of strawberries are shipped out of the county each season, as local markets are inadequate to consume the supply of this fruit. Cattle, hogs, and grain constitute the main sources of income of the greater number of farmers.

Water is readily obtained in all sections, mainly from wells, most of which are open dug wells. Water for livestock is commonly obtained by damming a small stream and impounding the water for future use. Several of the towns obtain their water supply from the larger streams.

CLIMATE

The climate of Neosho County is continental, with considerable differences between the winter and summer temperatures. A minimum temperature of −19° F. and a maximum of 108° have been recorded at Chanute, but such extremes are infrequent, as in some winters the temperature does not fall below zero, and ordinarily only 1 or 2 days occur during the winter when below-zero temperatures are recorded. In the summer, the weather becomes very warm, especially during times of drought, and temperatures of 100° are common. Damage by droughts, which usually occur during July and August, are caused as much by the high rate of evaporation and excessive sunshine as by a deficiency in rainfall. Blizzards are uncommon and of short duration. April is considered the windiest month, and August has the least wind movement, there being generally a marked range in the average daily velocity, increasing and decreasing with increase and decrease of temperature. The most

damaging winds are the hot winds which occur during prolonged periods of hot weather and which often attain a high velocity, causing great injury to growing crops. However, these winds are uncommon and irregular. High northerly winds often accompany the advent of cold waves.

The average date of the latest killing frost is April 9 and of the earliest is October 20, giving an average frost-free season of 194 days. Frost has been recorded as late as May 2 and as early as September 26.

The annual precipitation averages 39.07 inches. Of this amount, about 25 inches falls during the spring and summer months, when rains generally come in the form of thundershowers of short duration. May is normally the month of highest rainfall. Although a large part of the rainfall occurs during the growing season, in many seasons an excess of moisture during late spring and early summer seriously interferes with planting and cultivation of spring crops, as well as with wheat harvest, and periods of drought frequently follow. When abundant moisture in the spring causes puddling of the soil and shallow rooting of plants on land having a tough impervious subsoil at a slight depth, plants are very likely to suffer more from dry weather than the total precipitation would indicate.

Exceptionally heavy and continued rains in the spring and early summer of some years have caused serious overflows along Neosho River. This river is small compared to its drainage area, its banks are low, and its gradient is less than 2 feet to the mile. Its wide alluvial bottom lands are very productive, and the frequency of floods and the losses caused by them have required the expenditure of large sums of money in building levees to protect these lands from destructive overflows. Crops are drowned in many places within the leveed areas, as the flood water does not recede rapidly enough to enable the plants to survive.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation for Neosho County, as recorded by the United States Weather Bureau station at Chanute.

AGRICULTURAL HISTORY AND STATISTICS

The earliest industry of the country now included in Neosho County was livestock raising. Many cattle were pastured in the Indian Territory (now Oklahoma) and brought to this section to be wintered on corn and hay, but as the land became more thickly settled this system of feeding was gradually discontinued. The development of agriculture has been slow, as supplies, except those produced locally, had to be hauled over poor roads and across treacherous streams before the railroads were built. At first, agricultural efforts were limited to growing small patches of corn, wheat, oats, flax, and buckwheat, but later, larger acreages were planted to these crops, although the farmers were discouraged considerably because of the destruction of crops by grasshoppers, chinch bugs, and by flax wilt.

The type of agriculture has retained its original character with very little change, as livestock raising and grain growing have always been the chief agricultural pursuits, although dairying and poultry raising have been extensively developed in recent years.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Chanute, Neosho County, Kans.*

[Elevation, 940 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1917)	Total amount for the wettest year (1927)
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*
December	35.2	73	−9	1.54	0.85	2.35
January	33.1	75	−19	1.23	.71	1.56
February	36.6	78	−9	1.82	.20	.57
Winter	35.0	78	−19	4.59	1.76	4.48
March	47.0	95	13	2.84	4.30	5.66
April	59.5	89	25	4.62	3.64	15.12
May	65.4	91	34	5.00	4.89	6.17
Spring	57.3	95	13	12.46	12.83	26.95
June	75.1	108	46	4.99	2.68	8.62
July	78.9	108	50	3.95	2.00	3.20
August	79.1	108	46	3.44	2.79	8.70
Summer	77.7	108	46	12.38	7.47	20.52
September	72.0	102	34	4.74	3.15	5.96
October	60.0	94	26	3.03	.82	4.47
November	47.3	89	10	1.87	(1)	1.48
Fall	59.8	102	10	9.64	3.97	11.91
Year	57.5	108	−19	39.07	26.03	63.86

[1] Trace.

At present (1930), the agriculture consists chiefly of branches of the livestock industry. The greater part of all the feed crops is marketed through livestock. Originally corn was grown on a very large part of the cropped land, but as the natural adaptability of the soils and other factors of agricultural environment have become better understood, the acreage of corn has decreased both proportionally and actually. The acreage of wheat correspondingly increased, reaching its maximum about the time of the World War, but during the last few years, competition from the specialized wheat-producing areas, where large-scale production through the use of improved machinery prevails, has caused a decrease in the acreage of wheat. The acreage of corn, grain sorghums, and other feed crops has correspondingly increased during this time, owing to a tendency to return to the early preference for livestock production. This tendency is partly due to increased attention to dairying, as this industry is making progress in southeastern Kansas.

Most of the corn is fed on the farms where produced, to hogs, dairy cattle, and beef cattle, but in most years some is shipped out of the county. In some seasons some corn for feed is shipped in. Frequent droughty periods during July and August have caused a decrease in the corn acreage on the heavier prairie soils, its place being taken in part by wheat and to considerable extent by grain sorghums and forage crops. Corn was grown for grain on 43,175 acres in 1929, with an average acre yield of 15.8 bushels. Sweet corn and pop corn are grown in small patches for local consumption.

Wheat is the principal cash crop. In 1929, 34,562 acres were planted to wheat which produced 299,614 bushels, or an average acre yield of 8.7 bushels.

The oat crop is important, oats being grown for grain on 17,922 acres in 1929, with an average acre yield of 15.3 bushels. Most of the oats are consumed on the farms where produced.

Flax has been an important crop on many farms since 1880, but the production has varied greatly, owing to economic conditions, as, when prices of grains are low, many farmers grow flax. Market conditions also have greatly influenced the production from time to time. Most of the flaxseed goes to the mill at Fredonia, Wilson County.

Native-grass hay is the most important hay crop, but its acreage is gradually decreasing on account of the slowly increasing acreage of cultivated crops. In 1929, 23,287 acres in wild grasses produced 27,149 tons of hay.

The acreages devoted to clovers and alfalfa have increased at a moderately rapid rate during the last few years. The alfalfa acreage in 1899 amounted to 56 acres and of clover to 736 acres. The 1930 census reports 2,800 acres in alfalfa and 1,311 acres in clover in 1929. These crops do well on the well-drained alluvial soils and on the better members of the Summit, Labette, Newtonia, and Crawford soils.

The grain sorghums have become rather important crops during the last 30 years. The occurrence of droughts and the presence in rather large acreages of soils with heavy clay or claypan subsoils tend to produce conditions which favor the production of these crops rather than corn.

Table 2, compiled from the reports of the Federal census, gives the acreage and production of the principal crops in Neosho County in 1879, 1889, 1899, 1909, 1919, and 1929.

TABLE 2.—*Acreage and production of principal crops in Neosho County, Kans., in stated years*

Crop	1879		1889		1899	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	66,890	1,920,159	90,949	2,497,707	97,519	2,307,050
Wheat	12,000	149,450	9,840	176,585	14,028	124,470
Oats	6,758	117,988	17,640	427,386	22,255	624,480
Flaxseed		9,340	5,617	47,943	13,702	93,050
		Tons		*Tons*		*Tons*
Tame hay	[1] 23,043	[1] 25,277	[1] 50,143	[1] 61,420	7,956	13,633
Wild hay					30,036	35,659

Crop	1909		1919		1929	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	90,228	1,750,047	31,146	748,075	43,175	682,397
Wheat	14,721	193,269	75,182	1,302,409	34,562	299,614
Oats	8,266	170,933	30,604	679,146	17,922	275,516
Grain sorghums	7,111	127,336	4,805	60,100	14,835	165,025
Flaxseed	6,322	42,965	2,928	17,912	3,202	15,759
		Tons		*Tons*		*Tons*
Tame hay	13,393	15,586	7,766	16,874	8,124	11,119
Wild hay	27,035	31,611	26,805	31,790	23,287	27,149

[1] All hay

Several minor crops are grown in widely scattered parts of the county. Barley occupied 3 acres in 1929, potatoes 249 acres, sweet potatoes 55 acres, and sorgo 82 acres. Tobacco and hops were at one time grown to a small extent, but practically none of these crops is now grown.

Apples and pears are the principal orchard fruits. Little attention is given to pruning, spraying, or fertilizing the trees. Strawberries are the principal small fruit grown, 97,242 quarts being produced on 75 acres in 1929. Some raspberries and Logan and other blackberries are grown for home use and local markets.

Vegetables are grown commercially only near the towns, and many market gardens are located near Chanute and Parsons. The vegetables are sold locally in the towns, only small quantities being shipped out of the county. Most farmers have small home gardens. The principal vegetables grown are rhubarb, tomatoes, carrots, potatoes, sweetpotatoes, spinach, sweet corn, radishes, onions, cabbage, beans, peas, cucumbers, lettuce, cauliflower, parsnips, turnips, and beets. Pumpkins, cantaloups, squash, and watermelons do well on the more sandy soils.

Wild and cultivated pecan trees, numbering more than 9,000, about one-half of which were in bearing, were growing on the alluvial soils of the county in 1929. Pecan orchards should be successful on such lands if proper care is used in getting the trees started.

Beef cattle, dairy cattle, hogs, sheep, and poultry are important sources of income on most farms. According to the twenty-ninth report of the Kansas State Board of Agriculture, there were 6,969 horses, 1,718 mules, 10,455 milk cows, 12,745 other cattle, 4,387 sheep, and 17,865 swine on the farms of Neosho County in 1929.

On most farms the buildings are fairly well constructed. They include barns, hog houses, machine sheds, corncribs, and poultry houses. A few barns, mainly on dairy farms, have basements and are equipped with stanchions, litter carriers, hayforks, and other labor-saving devices, and some farms have silos.

The work animals, in most localities, are old and are decreasing in quality and value. Most of the horses are of medium weight, ranging from 1,100 to 1,400 pounds. A large number of mules are used, but they also are of medium quality. The number of horses and mules decreased very rapidly in the 10 years preceding 1930, the census of that year reporting only 7,511 horses and 1,586 mules on April 1.

The decrease in the number of horses and mules has been accompanied by a corresponding increase in the number of tractors, trucks, and automobiles. The 1930 census reported 2,040 automobiles, 168 trucks, 409 tractors, 37 electric motors, and 381 stationary gas engines.

Most of the plowing is done with sulky plows drawn by three horses, or by two-bottom tractor plows. The small size of farms and small irregularly shaped fields are not convenient for large-scale power farming.

Practically all the wheat is harvested with binders, although the combine is being used to a small extent, but the small fields and humid climate are not favorable to the use of the combine. Thresh-

ing begins as soon as all the wheat and oats are cut, being done mainly from the shock. Plows, harrows, disks, cultivators, corn planters, and listers are the implements used on nearly all farms. Manure spreaders are used on a few farms only.

There are very few herds of beef cattle, but some very good dairy herds are maintained, Jerseys and Holstein-Friesians predominating, with some Guernseys and milking Shorthorns.

Dairying is a very important industry and fits well with a plan of diversified farming. The soils support a good growth of Kentucky bluegrass, English bluegrass, and other pasture grasses, which makes dairying profitable. A few milk cows are kept on nearly every farm. A few purebred dairy cows are on some farms, and most of the bulls are registered. Butterfat is the most common dairy product, but a large quantity of whole milk is sold, both in the larger towns and to condensaries in adjoining counties. Some butter and cheese are sold for local use. Dairy products comprised 18.02 percent of the total value of farm products in 1929.

Most of the beef cattle are grade Shorthorns, Herefords, and mixed dairy and beef breeds, but a few are purebred. The average number to the farm is between 10 and 15 head, and in most years some feeders are shipped in from Oklahoma and Texas, being usually purchased in the spring, pastured during the summer, and then finished before going to the Kansas City market.

The raising and feeding of hogs is not an important phase of the livestock industry, those fed being mainly for local and home consumption. Hampshire, Duroc-Jersey, Poland China, and Chester White are the most common breeds.

Sheep raising is of minor importance. Grade Shropshires predominate. Most of the sheep are raised in the rougher areas and are used to keep down weeds and crabgrass in cornfields after the corn is too large to cultivate. They are marketed in Kansas City in early summer.

Practically every farmer produces some poultry and eggs, and some raise ducks, geese, guinea fowls, and turkeys. The 1930 Federal census reports 257,567 chickens on April 1 of that year. The average flock numbers about 125. Many of the flocks are mixed, but some consist of purebred birds. Rhode Island Red, White and Barred Plymouth Rock, White and Brown Leghorn, Buff and White Minorca, and White and Buff Orpington are the chief breeds of chickens. Much culling is being done with good results. The eggs and poultry are marketed both locally and through poultry shipping houses in Chanute, Thayer, Galesburg, Erie, St. Paul, and Stark.

According to the 1930 census, 350 farms reported the expenditure of $26,438 for fertilizer in 1929, including lime, for which a large part of this amount was undoubtedly expended. Phosphatic fertilizers, chiefly bone meal, superphosphate, and rock phosphate, are practically the only commercial fertilizers applied. These are applied mainly to wheat, though some is used on alfalfa.

Labor is plentiful enough to supply the demand. At harvest time, day laborers are paid from $1.50 to $3.50, but at other times labor may be procured at a monthly wage ranging from about $25 to $40 with board. Most of the employees are white. A few farm managers are paid substantial salaries.

The average size of farms in Neosho County in 1930 was 151.1 acres, and in 1900 was 139 acres, indicating that there has been no pronounced change in size within the last 30 years. Most of the farms are between 50 and 500 acres in size. Of the total area of the county, 87.7 percent is in farms, of which 71.7 percent is classed as improved land, including crop land and plowable pasture.

Table 3 shows that the proportion of farms operated by owners has decreased since the early development of the county. The highest proportion of tenancy was recorded in 1910, and a slight decrease has taken place since that time.

TABLE 3.—*Proportion of farms in Neosho County, Kans., operated by owners, tenants, and managers in stated years*

Year	Farms operated by—			Year	Farms operated by—		
	Owners	Tenants	Managers		Owners	Tenants	Managers
	Percent	*Percent*	*Percent*		*Percent*	*Percent*	*Percent*
1880	74.6	25.4	0.0	1910	55.6	43.8	0.6
1890	63.0	37.0	.0	1920	58.3	41.2	.5
1900	58.5	41.2	.3	1930	57.9	41.9	.2

The most common form of rental is the crop-share plan. In 1930, 702 tenants rented on this plan, only 200 renting for cash.

In 1930 the value of all property per farm was $7,938, the land comprising 60 percent of the total value. It is interesting to note that in 1880 the average value of all property per farm was $3,621, of which the land comprised 61.3 percent. The average value of land and buildings per acre in 1930 was $43.28.

SOILS AND CROPS

The underlying rock formations of Neosho County are limestone, sandstone, and shales. The weathering of these formations has produced decomposition products which differ to a comparatively slight extent where completely weathered, but the soil-making forces, influenced strongly by the character of the local relief, the thickness of the layer of decomposed material, and the degree of perfection of surface and subsoil drainage, have produced soils which differ widely in character in different parts of the county. The dynamic soil-making forces operating in the county have been the two types of natural vegetation—grass and forest. To the differences produced by each of these two kinds of vegetation, as well as those due to the extent of activity of each kind, must be added variations in character of the decomposed rock material.

Many of the soils are developed in continuous areas, ranging in extent from a few to several square miles, whereas others include a comparatively small acreage and are widely scattered. Surface relief is a modifying factor influencing the development of the soils, particularly as it affects the depth and character of the surface soils. The upland soils are fairly well drained. They control the agriculture and also govern the distribution and concentration of the farms.

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More than 70 percent of the land is tillable, and the rest is rough stony land and creek and river bottoms, part of which is in pasture. The tillable land is topographically well suited to farming and allows the use of labor-saving machinery. Small areas of forest land occur, on which hickory, walnut, maple, bois d'arc, elm, and other trees grow.

Corn, the principal crop, is grown on all the farms, but the higher yields are produced on the soils with friable subsoils. Wheat is grown mainly on the claypan soils. Oats are grown chiefly as a rotation crop between corn and wheat. Flax is grown on the heavier soils, as it leaves the land in a very mellow condition. Hay is a very important crop used by all farmers and is produced on all types of soil. Alfalfa, sweetclover, red clover, and soybeans are increasing in acreage on the better soils and are important as soil builders. Korean lespedeza and alsike clover are growing in many pastures.

In order to bring out the relationships existing between the different soils and the agriculture, the soils are divided into five groups, the soils of each group having common characteristics in soil profile and crop adaptation. These five groups are as follows: Group 1, the Cherokee, Parsons, and Woodson soils; group 2, the Summit soils; group 3, the Labette and Newtonia soils; group 4, the Bates soils; and group 5, the alluvial soils. Group 1 occupies 37.2 percent of the area of the county; group 2, 17.9 percent; group 3, 18.4 percent; group 4, 12.2 percent; and group 5. 14.3 percent.

The soils in group 1 occur in large continuous areas in all except the northeastern part, where only a few small areas are present. Group 2 is best represented in the section between Erie and Stark, but soils belonging to this group are scattered over most of the county. Group 3 is closely associated with group 2, and the soils occur in the same sections. The soils of group 4 are in the vicinity of Thayer and on the east side of Neosho River east of Chanute; and those of group 5 lie mainly along Neosho River. The soils of each group largely determine the agriculture in their particular section.

In the following pages the soils of Neosho County are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 4.

TABLE 4.—*Acreage and proportionate extent of soils mapped in Neosho County, Kans.*

Type of soil	Acres	Percent	Type of soil	Acres	Percent
Cherokee silt loam	17,984	4.9	Bates loam	22,976	6.2
Woodson silt loam	9,536	2.6	Bates very fine sandy loam	21,248	5.8
Parsons silt loam	109,568	29.7	Bates shale loam	768	.2
Summit silty clay loam	48,896	13.3	Verdigris silty clay loam	16,384	4.4
Summit silty clay loam, shallow phase	7,040	1.9	Verdigris silt loam	12,416	3.4
Summit stony silty clay	9,984	2.7	Osage silty clay loam	16,448	4.4
Labette silt loam	35,968	9.7	Osage clay loam	6,912	1.9
Labette gravelly silt loam	5,824	1.6	Osage clay	768	.2
Labette cherty silt loam	18,688	5.1	Total	368,640	
Newtonia silt loam	4,288	1.2			
Newtonia silt loam, shallow phase	2,944	.8			

SOILS OF GROUP 1

The soils of group 1 have grayish-brown surface soils with heavy dense claypan subsoils. All crops are grown on them, but those with shallow root systems and late-spring or early-summer period of maturity, or those which are capable of enduring midsummer droughts, succeed best. The first group of crops includes wheat and flax, and the second, the various grain sorghums and sorgo. Because of the presence of a heavy tough clay subsoil in all the soils of this group, moisture conditions range from excessive wetness in periods of heavy rainfall to excessive dryness in periods of low rainfall. Because of the thin surface layer above the claypan, the water-holding capacity of these soils is small, causing the extremes of wetness or dryness just described.

These soils lie on flat or gently undulating relief and are comparatively light in color. Natural surface drainage ranges from fair to good and internal drainage from fair to poor, as indicated by some mottling in the subsoils. The structure is not favorable for aeration, oxidation, and the movement of moisture. Erosion is not very active, being noticeable only along the small streamways in long-cultivated fields (pl. 1, *A*). The surface soils of these soils are dominantly silt loams, they range in color from dark grayish brown to light gray, and they have a smooth floury feel. The subsoils are drab dominantly heavy claypans, with some red and yellow mottling. They are plastic and waxy when wet and hard and compact when dry. They contain various quantities of calcium sulphate and sodium sulphate, which are noticed along road cuts and ditches when the soil material becomes dry. In all these soils the parent shale material lies from 40 to 60 inches below the surface.

These soils are low in organic matter. They range from slightly acid to acid. They do not favor deep rooting of plants, on account of the heavy claypan which restricts underdrainage and causes the formation of a high water table. The heavy clay subsoil is too dense for the plant roots to penetrate, and the small roots are exposed on the surface and occur in cracks and cleavage planes. Optimum moisture conditions endure for only a short time. Good tilth is hard to obtain. Heavy spring rains cause the soil to puddle if worked while wet, and in many places water stands on the surface until it evaporates, leaving crops in poor condition to withstand dry weather.

Only shallow-rooted plants with wide-spreading root systems, such as the grain sorghums, wheat, meadow fescue, flax, and a few annual legumes, can be grown with profit on these soils. The grain sorghums do fairly well, as they remain dormant in dry periods and mature later when the season is more favorable. Corn cannot withstand the adverse moisture conditions as well as the grain sorghums and is a somewhat uncertain crop. The best varieties of corn for this section of the State are Midland Yellow Dent, Pride of Saline, Commercial White, and Freed White. Freed White is the best adapted variety for the thin claypan soils. The grain sorghums yield more than corn and are more certain. Blackhull, Sunrise, and Red kafir varieties are especially suited to soils of this group. The Fulcaster variety of wheat is grown more commonly than any other variety. Kanvale, a new variety, produces higher yields than Ful-

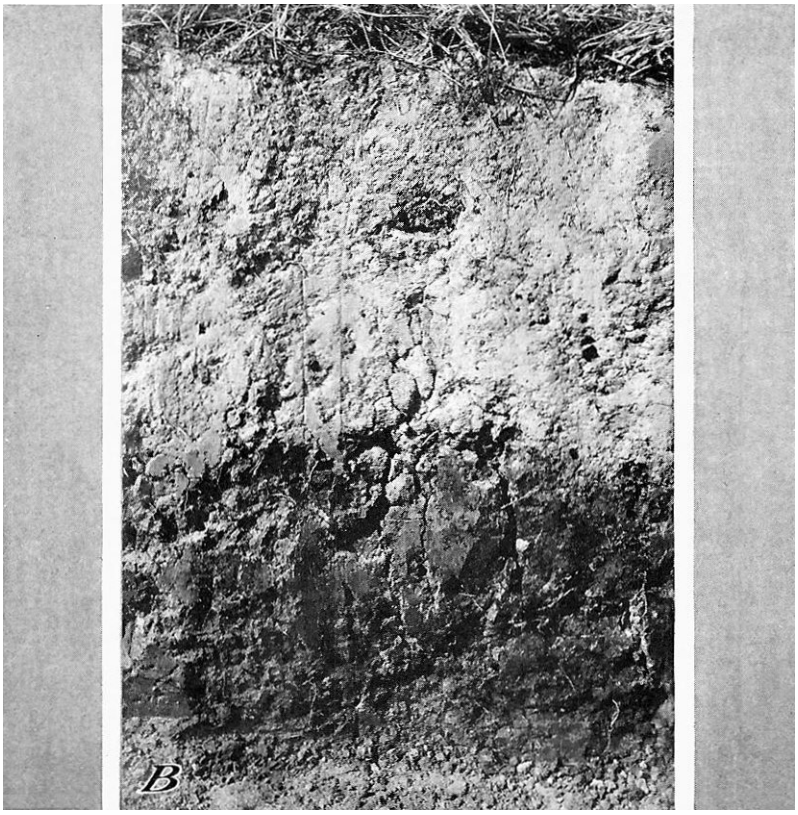
caster. Currell, and Dunbar Currell are other varieties which produce well in this section of Kansas. In favorable years such legumes as cowpeas, soybeans, red clover, and sweetclover are grown. The varieties of soybeans that do well on these soils are A. K., Peking (Sable), and Laredo. These are grown for hay, grain, and as soil-improvement crops. Flax is grown to some extent, and Linota is the best adapted variety.

The light-colored claypan soils are more uniform in their surface features than the darker colored soils, and this characteristic allows seed crops to mature more uniformly and simplifies harvesting. With the exception of yields of native grasses, the soils of this group produce comparatively low crop yields, owing to low fertility and lack of drought resistance, drought resistance being of much the greater importance because droughts are rather frequent. Experiments have shown that grain sorghums will return higher yields on these soils than will corn, but many of the farmers have come from corn-growing States and still cling to corn production. The average acre yield of corn is about 18 bushels; of wheat, 15 bushels; of kafir, 30 bushels; and of tame hay, about 1 ton.

Cherokee silt loam.—Cherokee silt loam, or the so-called "ashy land", has developed in the more level parts of the county. The profile characteristics are very distinct (pl. 1, *B*). The flat relief, together with the heavy claypan subsoil, renders drainage poor in wet weather. The physical condition is in general poor, and plowing when wet causes the soil material to puddle. The surface soil, to a depth ranging from 7 to 18 inches, is grayish brown or dark gray, the shade depending on the organic matter present, and it is of silty porous character. The lower part of the surface layer, or that part just above the claypan, has been severely leached of available plant nutrients and after plowing gives the field a light-gray appearance. This soil is almost white when dry, and it contains many small rounded ferruginous concretions. The water table is very high and stands over the claypan layer after spring rains and either seeps off or evaporates. This layer begins abruptly at a depth of about 14 inches. It consists of drab or grayish-brown heavy compact clay mottled with reddish-brown and yellow stains. On drying the granules are hard, coarse, and angular. The larger granules are coated and have a distinctly glazed appearance. With increasing depth the subsoil becomes lighter in color and texture and at a depth of about 40 inches changes to yellowish-gray shaly silty clay. Partly weathered shale and sandstone, from which the Cherokee soil material is derived, occur at a depth of 5 or 6 feet in most places. In plowed fields the surface soil shows an ash-gray color when dry but is almost black when wet (pl. 2, *A*). The pH value of the soil material in plowed fields ranges from 4.5 to 5. Crop yields are a little less than the average on the soils of the first group as a whole.

Those areas of Cherokee silt loam lying along Neosho River, especially those on the smooth terraces, are somewhat darker, and the dark-colored layer is somewhat thicker than in other areas of this soil. These areas are intermediate in character between the Cherokee and Parsons soils but are more like the former than the latter.

Woodson silt loam.—The surface soil of Woodson silt loam is dark grayish-brown or almost black silt loam from 7 to 12 inches



A, Eroded area of Cherokee silt loam. *B*, Freshly exposed profile of Cherokee silt loam.

A, Weathered profile of Cherokee silt loam. *B*, Stony area of Newtonia silt loam, sl

thick. The subsoil begins abruptly at an average depth of about 10 inches and is very dark drab or dark grayish-brown dense clay. Between depths of 24 and 30 inches the material grades into olive-yellow clay. In many places calcium carbonate concretions are present in the clay. Below a depth ranging from 40 to 50 inches, the subsoil is underlain by soft decomposed gypsiferous shales. The surface soil contains a fair supply of organic matter and is rather dark when dry and almost black when wet. The pH value of the soil in plowed fields ranges from 5.5 to 6.5. Average yields, especially of corn, are a little higher than on the other soils of group 1.

Parsons silt loam.—Parsons silt loam is similar to Cherokee silt loam. The surface soil is darker and thicker than the corresponding layer in Cherokee silt loam, and the subsurface layer is not so gray and is less thick than the corresponding layer in the Cherokee soil. The Parsons soil occurs on slightly uneven relief, surface drainage, therefore, being better than in the Cherokee soil. The differences between the two soils are those which express a less advanced stage in the development of the characteristic features in the Parsons soils than in the Cherokee. These features consist of the gray subsurface layer and the claypan. The thinner and less well developed gray layer in the Parsons soil assures a thicker and darker surface soil, and the thinner gray layer reflects a less dense and less impenetrable subsoil. In general the physical condition of the Parsons soils is better than that of the Cherokee. The subsoil is uniformly not so dense, and plant roots can penetrate it somewhat more readily. Corn will produce a little more than the average yield on the soils of the first group, if the moisture is sufficient during the late growing season. Soybeans and cowpeas do fairly well.

SOILS OF GROUP 2

The Summit soils, or the soils which have dark-colored surface soils and olive-drab clay subsoils, comprise group 2. They occur in many odd-shaped patches which form an ill-defined belt from the northeastern to the southwestern corners of the county. The largest areas extend in a broken belt from the vicinity of Stark southwestward to the vicinities of Urbana and Galesburg. This belt includes the greater part of the so-called black lands.

Chemical analyses of the darker soils show a higher content of nitrogen and in general a larger supply of available nutrients, to a depth ranging from one-half foot to 2 feet, than in the lighter colored soils. The dark-colored soils show less marked response to fertilizer than the lighter colored claypan soils. The dark-colored soils are almost neutral in reaction, whereas the light-colored soils are acid. The organic matter is so intermixed with the mineral constituents that it is an integral part of the soil. It imparts the crumb structure so desirable for tillage, is highly conducive to the maintenance of good moisture conditions, and is the chief source of soil nitrogen. Nitrification is not stopped or retarded in the Summit soils, except in extremely wet or extremely dry periods. The physical condition of the dark-colored soils is generally good, enabling the crops to withstand dry weather conditions and recover rapidly from the effects of heavy rains. In a few places erosion has removed much of the dark-colored surface soil, causing a tendency to bake, puddle,

and crack. In long-cultivated fields soils of this group crack and allow great quantities of the surface soil to fall into the subsoil. This gives the soil an uneven textural appearance. This form of erosion is noticed only where organic matter is depleted. Corn yields from 35 to 50 bushels an acre, and acre yields of crops in general are about one-fifth more than on the soils of group 1.

Summit silty clay loam.—Summit silty clay loam is the most extensive soil of the second group. It is characterized by a dark-colored surface soil, the lower part of which, between depths of 12 and 20 inches, averages lighter in color and slightly heavier in texture than the overlying silty clay loam layer, but it retains a distinctly granular structure. The subsoil is heavy dull-drab clay loam mottled with gray and yellow, which is coarsely granular and cloddy. When the granules are crushed the color is lighter, indicating that the dark coating is only on the outsides of the granules. This material gradually passes into yellowish-gray clay.

About 95 percent of the area of this soil is in cultivation, mainly to corn, although many other crops do well. The high content of organic matter and the fine texture cause the soil to be somewhat too moist for wheat production. In early spring the land is often too wet to allow early planting of corn, and crops during this period often have a pale-green color because of too much moisture and lack of nitrification. The best-adapted varieties of corn are Midland Yellow Dent and Commercial White. They mature about 1 week later than most varieties, but the yield is higher.

Summit silty clay loam, shallow phase.—The shallow phase of Summit silty clay loam is similar in its upper layers to typical Summit silty clay loam. Limestone occurs at a depth ranging from 12 to 36 inches beneath the surface soil. Soil of this phase occurs in small areas, mainly on slopes where erosion is active. The soil is somewhat less productive during dry years than the typical soil, but during seasons of heavy rainfall yields on the two soils are about the same. Cultivation is somewhat more difficult on the shallow soil, on account of the limestone fragments in the soil and the slight depth to bedrock. Erosion, which has produced this shallow soil, is still going on. The land can best be used for clover pasture, as clover grows well on it and retards erosion.

Summit stony silty clay.—Summit stony silty clay is a little heavier than Summit silty clay loam, and it has loose fragmental limestone scattered over the surface. This soil contains fragments of platy limestone and calcareous shales, and the lower part is calcareous. The surface relief ranges from gently to sharply rolling. The land is used mainly for pasture, but the grasses from some patches of the less stony areas are mowed for hay.

SOILS OF GROUP 3

The soils of group 3, or the Labette and Newtonia soils, have dark-brown silty surface soils and reddish-brown silty clay subsoils. In places where erosion has removed the dark-colored surface soil, the reddish-brown clay subsoil is exposed. These soils are well drained and well oxidized and are closely associated with the soils of group 2. Most of the soils of group 3 occur in small areas and are so intermixed with soils of other groups that few farmers are able to farm

the soils of this group separately. Surface drainage is slow, but internal drainage ranges from fair to good. These soils contain a fair supply of plant nutrients and humus, but the dark-colored surface soil is not so thick as in the Summit soils, and the surface soils are slightly more acid.

About 95 percent of the soils of this group is in cultivation, mostly to corn and wheat, and small quantities of alfalfa, clover, sorghums, and flax are grown. Yields are much higher on these soils during wet years and much lower during dry years, owing partly to the considerable run-off on the rolling surface relief on which they lie and partly to their rather rapid drying.

Labette silt loam.—Labette silt loam is the representative soil of this group. The surface soil is dark grayish-brown finely granular silt loam. Organic matter decreases with depth, and the soil becomes lighter in color and heavier in texture. The surface soil merges gradually into the lighter colored heavier subsoil which has a coarse-granular structure, with the angular structure particles becoming larger and more dense with increasing depth. Various quantities of ferruginous pellets are present throughout this soil. It generally occupies the higher and better drained areas within those parts of the county underlain by limestone beds. The pale-green color characterizing plants growing on the Summit soils in early spring is not so noticeable on this soil. A little more lime is necessary to correct the acidity of Labette silt loam than that of the Summit soils. Alfalfa and clovers grow well when the acidity is corrected.

Labette gravelly silt loam.—Labette gravelly silt loam occurs on the higher slopes adjacent to Neosho River. It differs from Labette silt loam principally in its content of water-worn rounded cherty gravel. In many places the gravel is used for road material, and in other places the land is used principally for pasture and hay land.

Labette cherty silt loam.—Labette cherty silt loam is similar to Labette silt loam, differing from that soil principally in the presence of small hard fragments of chert or flinty stones in the subsoil. Pockets of chert occur at more or less regular intervals about 3 feet below the surface. In long-cultivated fields where erosion has been active, these fragments are near the surface and interfere somewhat with plowing and tillage operations. Corn, wheat, and flax are the principal crops grown, and yields are about the average for the county, except in dry years. The chert fragments cause the soil to be a little droughty.

Newtonia silt loam.—Newtonia silt loam is similar to Labette silt loam in physical features as well as agriculturally. It differs from that soil principally in color and a considerably lower content of organic matter in the surface soil. In cultivated fields it is locally called "red limestone soil." The surface soil is usually rich brown, but it appears red in cultivated fields where organic matter is lacking, especially when wet. In most places nitrogen is not plentiful, but it is usually sufficient to produce a fair corn crop. The soil material is very friable and has a loose imperfect crumblike structure. In some places the brown layer is very thin, and in other places it has entirely disappeared, leaving the red layer exposed. In such places the soil is inclined to be more droughty than else-

where. This soil seems to be well suited to such fruits as peaches, pears, plums, cherries, and apples. Potatoes do especially well and mature much earlier than on the Summit soils.

Newtonia silt loam, shallow phase.—The shallow phase of Newtonia silt loam differs from typical Newtonia silt loam only in its shallowness. Bedrock lies at a depth of less than 3 feet—over the greater part of the area occupied by this soil, at a depth ranging from 12 to 24 inches. The soil is somewhat droughty in places, especially near outcrops of limestone. Crop yields are in general much lower than on typical Newtonia silt loam. The early-maturing crops do well, as they mature before the late summer droughts set in.

Locally this soil may be stony, especially where the underlying limestone beds lie at less depth than usual and are somewhat broken up (pl. 2, *B*). The content of stone differs between wide limits. The soil has a low content of organic matter, as most of the surface soil has been eroded. The land is utilized at present only as pasture.

SOILS OF GROUP 4

The soils of group 4, the Bates soils, have grayish-brown sandy surface soils and yellowish-gray sandy clay subsoils. Surface drainage is slow but good, and internal drainage is generally fair. Both surface soil and subsoil are acid in reaction. The physical condition of the soils of this group is in general good, but the content of lime, potash, phosphoric acid, and nitrogen is low. The low nitrogen content is indicated by the light color of the soil material, which is due to the low content of organic matter; whereas the low content of the other constituents is caused by the low content of these constituents in the parent sandstone rocks and the leaching to which they have been subjected. Because of the sandy texture, leaching has been more severe than on the heaviest soils of the previously described groups. Most of this land is in native grasses which are used for hay and pasture. Corn and the grain sorghums are the principal cultivated crops. Special crops, such as watermelons, cantaloups, rhubarb, tomatoes, and other truck crops, do better and are usually of high quality when grown on these soils. Most of these special crops receive a top dressing of manure or commercial fertilizer.

In many places the Bates soils are thin and are very erosive, especially on the slopes, the underlying thin-bedded yellow noncalcareous sandstone occurring at a depth ranging from 12 to 24 inches. Where the soil is 2 feet or more thick, crops withstand drought fairly well, as yields depend on the thickness of soil and distribution of rainfall. The sorghums yield about 30 bushels to the acre, corn about 20 bushels, and hay about three-fourths ton.

Bates loam.—The surface soil of Bates loam consists of an 8- to 12-inch layer of dark grayish-brown loam underlain by friable granular yellow silty clay. At a depth ranging from 1 to 2 feet, this material is underlain by thin shalelike noncalcareous sandstone. Erosion has exposed the lower layers in many places in long-cultivated fields. Kafir is the main crop grown on this soil.

Bates very fine sandy loam.—Bates very fine sandy loam closely resembles Bates loam, the principal difference being the somewhat coarser, or more sandy, texture of the surface soil in the very fine

sandy loam. The same crops are grown, and the same utilization is made of this soil as of Bates loam. The surface soil is a little darker and contains a little more very fine sand than the loam.

Bates shale loam.—Bates shale loam is comparatively unimportant agriculturally, owing to its small area and unproductiveness. It occurs mainly in the south-central part of the county, east of Excelsior School. The surface soil is very shallow—in places entirely lacking—leaving only the parent shaly material exposed. The land has little or no agricultural use. A few small areas of stony soil, belonging to the Bates series and consisting chiefly of sandstone outcrops and loose fragmental sandstone, occur in the southwestern part of the county. The total area covered is less than 50 acres and is waste land.

SOILS OF GROUP 5

The soils of group 5 are alluvial soils including members of the Verdigris and Osage series. They occur along the larger streams of the county and are flat or very gently sloping. The texture of the surface soils differs considerably, ranging from silt loam to clay, and the range in color is from brown to almost black. Natural surface drainage is good near the streams but only fair or poor back from the streams. Internal drainage is good in the Verdigris soils and poor in the Osage soils. The Osage soils are poorly oxidized and show some mottling in the lower layers. About 75 percent of the land occupied by soils of this group is in cultivation.

These are the most productive soils in the county, the main crops grown on them being corn, wheat, alfalfa, red clover, and prairie hay. Acre yields of corn range from 30 to 75 bushels, wheat from 12 to 25 bushels, and forage crops from 1 to 4 tons. The soils of this group are slightly acid or neutral, and alfalfa and clovers can be started without liming or inoculation. The more poorly drained areas along the creeks are still in their virgin condition and support a good growth of virgin timber and marsh grasses. The better drained soils support a vigorous growth of black oak, pin oak, elm, hickory, sycamore, walnut, locust, maple, willow, pecan, ash, and hawthorn. Very few farmhouses are located on these soils, owing to overflows, poor drinking water, and insects. Their frequent subjection to overflows causes considerable damage and loss of crops. The farmers have organized levee districts and have built many miles of levees to protect their crops from floods, but the levees have been washed out in many places and the crops destroyed. The levees were built too close to the river bank, allowing only a small space to carry the flood waters. Floods at times inundate the whole flood plain and do great damage to levees as well as to crops. The levees in most places protect the more poorly drained Osage soils which are naturally somewhat less productive than the other alluvial soils, but a large part of the Verdigris soils lies between the river and the levees and is therefore not protected. Heavy local rains do almost as much damage to the more poorly drained Osage soils as do floods.

Verdigris silty clay loam.—The surface soil of Verdigris silty clay loam consists of light-brown or yellowish-brown silty clay loam which extends to a depth ranging from about 6 to 10 inches. It grades into lighter brownish-gray silty clay which extends down-

ward to a depth of 3 feet or deeper. In many places, especially on the outer sides of the river bends, the material in the lower subsoil layer varies considerably in color and texture and shows water stratification and mottlings of gray and rust brown. This is a very productive soil, but overflows make yields uncertain. Corn and alfalfa are the principal crops. Corn yields from 50 to 75 bushels an acre and alfalfa from 3 to 4 tons from four cuttings.

Verdigris silt loam.—Verdigris silt loam differs from Verdigris silty clay loam mainly in being a little lighter in color and texture in the surface soil. The agriculture on the two soils is practically the same.

Osage silty clay loam.—Osage silty clay loam consists of grayish-brown or almost black silty clay loam to a depth ranging from 12 to 18 inches. This material is underlain by dark grayish-brown or drab silty clay which extends to a depth of about 40 inches, where it changes gradually to a lighter color. Various quantities of soft ferruginous pellets occur in the subsoil, and bluish-black and grayish-yellow mottlings are present in the lower part. This soil is slightly acid and contains a fair amount of organic matter.

The agricultural practices depend largely on drainage. Corn, wheat, oats, and clover are the principal crops grown, and yields depend largely on the moisture received during the season. Ordinarily, this is the easiest Osage soil to farm, as crops are not likely to be so much damaged in wet seasons because of the slightly more favorable surface drainage.

Osage clay loam.—Osage clay loam differs from Osage silty clay loam mainly in the texture of the surface soil. No difference was noted in crop yields or kind of crops grown. The drainage is not quite so favorable as that of Osage silty clay loam but more favorable than that of Osage clay.

Osage clay.—Osage clay is used very little for agriculture, and it is mainly in virgin forest, wild onions, and marsh grasses. It occupies the more poorly drained areas along the streams. Drainage is imperfect because of the heavy texture of the soil and the flat surface.

AGRICULTURAL METHODS AND MANAGEMENT

The productiveness of a soil can be increased or diminished by its treatment. Building up the productivity of a soil to a high level and afterward keeping it up is an achievement toward which every farmer should strive. The management of the farm should be as intelligent and as carefully conducted as that of any other business, in which every process must be understood and regulated in order to obtain the most profitable results, as the farmer's success depends largely on his knowledge and treatment of the soils. Different soils present different problems of treatment and kinds of crops to be grown, as the requirements of the soils may differ greatly, and both their chemical and physical condition must be understood. The requirements of plants also differ, and the farmer should plant the crops whose needs can best be satisfied by his soil.

The soils of Neosho County are somewhat lacking in available plant nutrients, but their most serious need is organic matter. The growing of alfalfa, sweetclover, red clover, and soybeans is necessary to

supply the nitrogen and organic matter lacking in these soils. Under a carefully worked out cropping system, approximately one-fourth of the acreage should be planted to legumes which should be fed to livestock and the manure returned to the soil. Sweetclover and red clover can be successfully grown on the heavy claypan soils, such as the Parsons, Woodson, and Cherokee, when lime is drilled in with the seed at the rate of 200 pounds an acre and the seed is inoculated. Soybeans and cowpeas seem to thrive and improve the soils to some extent without the use of lime, and the hay of these annual legumes is equal in nutritive value to alfalfa or clover hay. The popular varieties of soybeans are Peking, A. K., Morse, and Virginia. The Virginia gives the best results on the claypan soils. The popular varieties of cowpeas are Whippoorwill, Clay, and New Era.

The use of commercial fertilizers is well established. They are used principally on the small-grain crops and legumes, particularly alfalfa. Practically no commercial fertilizers are used on row crops, but the yields of row crops are greatly increased following legumes which require fertilizers. Barnyard manure gives good returns on all crops.

Lime and phosphatic fertilizer are necessary for the successful production of alfalfa on all types of upland soils in the county, especially the soils of group 1. Sweetclover can be grown successfully by drilling lime in with the seed at the rate of 200 pounds an acre.

The soils are low in phosphorus, and the use of phosphate fertilizers on wheat and alfalfa has given good increases. The fertilizers more commonly used are bone meal, superphosphate, and rock phosphate. Finely ground raw rock phosphate has given good increases on the Cherokee and Parsons soils when it is applied with manure or green-manure crops.

The Cherokee, Parsons, Bates, and Newtonia soils are low in available nitrogen which can best be supplied by growing inoculated leguminous crops, but a limited amount of nitrogenous material may be supplied in mixed fertilizers. Ammonium sulphate or sodium nitrate is used to good advantage on lawns, pastures, or on late-prepared wheatland, as the nitrifying bacteria have not had an opportunity to increase the nitrate nitrogen content of the soil. Some potash has been used experimentally in mixed fertilizers in this section, but the results obtained indicate that it is not greatly needed. Ground plowed during July generally produces from 2 to 4 bushels of wheat an acre more than ground plowed in August.

Very little systematic rotation of crops is practiced. The importance of a leguminous crop is generally recognized in diversified farming, and all the better rotations include a legume. A practical rotation used by the more progressive farmers is a 5-year rotation consisting of (1) corn or kafir, (2) oats, (3) wheat, (4) wheat, and (5) soybeans. The size and kind of farms govern the rotation system and kind of fertilizers used.

At the experiment substations at Columbus, Fort Scott, Parsons, and Rest, alfalfa, corn, and wheat were planted in plots of Cherokee, Summit, Parsons, and Labette soils, respectively. All crops were much better on the Summit than on the Cherokee soils, but

where fertilizers were used the crops were more uniform. The response to fertilizers was much greater on the Cherokee soils, but total crop production was greater on the Summit soils.

Table 5, taken from the reports of the southeastern Kansas experiment fields, shows the value of different fertilizer treatments on alfalfa on four of the more extensive soils in Neosho County.

TABLE 5.—*Average yields of alfalfa on southeastern Kansas experiment fields at Columbus, Fort Scott, Parsons, and Rest, 1925 to 1929, inclusive*

Treatment	Cherokee silt loam at Columbus	Summit silty clay loam at Fort Scott	Parsons silt loam at Parsons	Labette silt loam at Rest	Average of all fields	Increase over no treatment
	Tons	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
No treatment	0.77	1.69	1.07	1.84	1.34	
Lime	1.79	1.77	1.91	2.11	1.89	0.55
Lime and superphosphate	2.12	2.75	2.49	2.74	2.52	1.18
Lime, potash, and superphosphate	2.04	2.14	2.63		2.27	.93
Manure		2.22	1.87	2.20	2.09	.75
Lime and manure	2.31	2.29	2.46	2.79	2.46	1.12
Lime, manure, and superphosphate	2.24	3.36	2.88	3.41	2.97	1.63
Lime, manure, and rock phosphate	2.47	3.47	2.70	3.29	2.98	1.64

According to the report of the Kansas State Board of Agriculture, 82,867 acres, constituting 26.88 percent of the land in farms, were used for pasture in Neosho County in 1929. Most of these are farm pastures used for all the farm livestock, and they are in very poor condition. The first step toward improving them is to eradicate the weeds and brush, and on most farms this can be done by mowing at the proper time. Buckbrush may be killed by mowing about the middle of May; perennial weeds, such as ironweed, should be cut about July 1; and annual weeds, as ragweed, should be cut about August 10. After the weeds have been eradicated, it is advisable to reseed many of the pastures. It is very unprofitable to sow grasses or legumes without some preparation of the soil, and a light disking is usually sufficient where the character of the land will allow. A mixture of 4 pounds of redtop, 6 pounds of meadow fescue, 8 pounds of orchard grass, and 2 pounds of Korean lespedeza an acre is well suited for sowing in most of the run-down pastures. The seeding should be done in early spring.

After a new stand of grass is obtained, it must be properly grazed or the pasture will soon be in the same condition as before reseeding. One of the most important precautions is to avoid overgrazing, especially early in the season, as the grass must get a good start before livestock are turned in. Each cow or horse should have 2½ or more acres of pasture, depending on the quality of the land.

It is good practice to supply temporary pasture for early spring and late fall grazing, and winter rye is well suited to this purpose. It should be sown in August or early September and in most years will furnish feed from about the middle of October until late in December. It will also furnish pasture early in March and can be used until May, when the permanent pasture can be used without injury. The rye can then be turned under in time to plant sorghums or other summer crops. Where it can be grown, sweetclover makes an excellent supplementary pasture for early spring and also during the drier months when grass does not make much growth.

Many of the soils of this county have heavy claypan subsoils and are not adapted to tile drainage, but improving the surface drainage by properly constructed ditches would be of much value. On some first-bottom soils, as the Osage, tile drainage would greatly improve the land, but, owing to the high cost, not much tiling has been done in recent years.

Owing to the high rainfall, considerable soil erosion takes place, even on some soils with very gentle slopes. This is particularly true where the crop rows run in the same direction as the slopes rather than across them. Keeping the land covered with a close-growing crop is the most effective method of reducing erosion. A cropping system which includes a small grain or soybeans, planted in close rows, and a sod legume, such as clover or alfalfa, as well as the cultivated crops, such as corn and sorghum, will aid in the control of erosion. This will be still more effective if the row crops are planted approximately on the contour, in order to prevent rapid run-off when the land is being cultivated. An additional precaution against erosion may be provided by the use of the Mangum terrace, but even where terraces are used contour farming when the land is in row crops is practical where the slopes are not too irregular.

SOILS AND THEIR INTERPRETATION

Neosho County lies in the prairie plains section of southeastern Kansas where the surface features and an adequate supply of moisture favor a grass vegetation over the smooth upland. Where the surface features have become modified by the cycle of erosion the slopes support a forest growth. The natural vegetation at the time of settlement of this section by white men, was grass over the comparatively smooth uplands and trees along the deeper stream valleys.

The soils have developed under the influence of a grass vegetation and a rainfall heavy enough to remove the readily soluble salts, and the grassy vegetation has caused the accumulation of large quantities of organic matter in the upper soil layers. This organic matter incorporated in the soil through the decay of grass roots imparts to the prairie soils their characteristic dark color. With an annual rainfall of a little less than 40 inches and a mean annual temperature of about 57° F., the soils are not extremely dark but are dark gray. Local differences in surface relief, parent material, and climate have caused the development of the different soil types. The parent material has had a great influence on the development of the soils. Surface relief has caused many of the minor variations in the soils, as the climate, vegetation, and parent material are much the same where minor variations occur.

For convenience of description, the soils have been placed, according to common characteristics, in five groups as follows: (1) Cherokee, Parsons, and Woodson soils; (2) Summit soils; (3) Labette and Newtonia soils; (4) Bates soils; and (5) alluvial soils.

The most extensive group is composed of the claypan soils which include the Cherokee, Parsons, and Woodson silt loams. These soils occupy slightly more than one-third of the area of the county and are well distributed. The Cherokee soils occur on the more level areas, and the Parsons and Woodson soils occupy the more undulating or sloping areas. These soils are very closely associated, and,

as their greatest differences are in the surface soils, their separation in the field is somewhat difficult, especially under the various moisture conditions. The differences in characteristics are principally owing to differences in relief. All other influences are nearly the same, except that the parent material of Woodson silt loam is gypsiferous shale and the parent materials of the Cherokee and Parsons soils are noncalcareous.

In a pit one-half mile west of the northeast corner of sec. 34, T. 30 S., R. 18 E., an area of Cherokee silt loam shows the following profile:

A_1. 0 to 5 inches, light grayish-brown structureless or faintly laminated porous silt loam. The color is uniform, except that the material contains a few pale rust-colored specks which blend with the surrounding matrix.

A_2. 5 to 14 inches, very light ash-gray or almost white porous laminated silt which is much lighter than the material in the layer above. It contains a few pale rust-colored specks, but the color is almost uniform. This material is slightly more acid than the overlying material.

A_3. 14 to 15 inches, a thin transitional gray layer merging with the claypan material. The ash-gray material thickly coats the dense clay particles, tongues of it extend into the clay particles along cracks, and peaks of clay particles extend into the surface layer. The lower half inch contains larger clay particles than the upper, and the gray siltlike material gradually gives way to the clay particles.

B_1. 15 to 24 inches, dark grayish-brown or drab extremely dense clay which breaks into irregular sharp-cornered, somewhat cubical, clods several inches in diameter. The structure particles lie close together and when moist adhere to one another so firmly that they can scarcely be separated. A broken lump, however, indicates by its slightly roughened surface some structural arrangement. The outsides of the structure particles are coated with dark grayish-brown material, and many particles have red and yellow or rust-brown centers. The material on drying breaks into fine fragmental particles with sharp angular corners. The material as a whole appears rather dark grayish brown or drab. Thin rust-colored stains are present on the soil particles. This is the densest layer in the soil.

B_2. 24 to 44 inches, grayish-brown or drab dense clay similar to the material in the layer above but not quite so dense and a shade or so lighter in color. The red and rust-brown specks are decidedly more yellow. A few gypsum crystals were noticed in the lower part of this layer just above the partly weathered shale.

C. 44 inches +, bluish-gray partly weathered soft argillaceous platy shale which becomes much harder with depth.

Studies made of Cherokee silt loam under different moisture conditions and at different places brought out some interesting features not noticed in the profile described. The contact line between the heavy layer and the gray layer is not horizontal but undulating, the undulations ranging from a few inches to almost a foot within a horizontal distance of a few feet and without any apparent regularity. Variations are as great on the flat areas as on the sloping areas, although the line is horizontal in many places. In the upper inch or so of the heavy B horizon a rust-red tinge may be seen when the material is dry.

Parsons silt loam differs from Cherokee silt loam in degree of development and in that it is slightly less acid in the upper layers. The Parsons soil has a darker and less laminated A_2 horizon, in which the granules are somewhat flattened and coated with a sprinkling of gray. The B_1 horizon, or claypan layer, is similar to that of the Cherokee soil, except that it seems to be less dense and a little

lighter in color. The B_2 horizon gradually becomes more friable than in the Cherokee soil, and the C horizon is similar to the corresponding layer of the Cherokee soil. The Parsons soil has not been so greatly influenced by water standing above the claypan as has the Cherokee soil.

Woodson silt loam differs from Cherokee silt loam in having a much darker and slightly heavier surface layer. The A_2 horizon differs but slightly from the A_1 horizon, and it merges more gradually with the claypan. The B horizon, or claypan, is not so compact and ranges from slightly acid to slightly calcareous and is gypsiferous. The C horizon is darker.

The Summit soils, comprising the second group, have dark-colored surface soils and heavy friable subsoils. They have weathered from gypsiferous shales and occur in isolated areas in all parts of the county, more especially in the northeastern part, on the lower slopes and around stream heads. They are fairly well drained.

In a pit about 75 yards south of the northwest corner of sec. 24, T. 28 S., R. 19 E., an area of Summit silty clay loam shows the following profile:

A_1. 0 to 2 inches, very dark grayish-brown silty clay loam which is faintly laminated or slightly granular and is covered with a dense sod containing much organic matter.

A_2. 2 to 7 inches, granular silty clay loam, in which the granules are heavily coated with organic matter and have semirounded corners. A slight sprinkling of gray is noticeable on the granules. Ferruginous pellets, the peripheries of which are black and the centers brown, are present. The soil appears brown when crushed but is almost black on a broken face.

A_3. 7 to 16 inches, material similar to that in the layer above, except the granules seem to be a little firmer, the organic coating thinner, and root hairs follow the cleavage planes between the structure particles. The material contains less organic matter and is more dense than that in the layer above.

B_1. 16 to 32 inches, dark-brown granular silty clay, in which the granules are lighter in color and a little firmer than in the layer above. The organic coating, which causes the dark color, becomes thinner with depth. The insides of many of the particles are red or rust brown, and the outsides are grayish red. The clay content gradually increases with depth.

B_2. 32 to 50 inches, yellowish-brown clay, in which the structure particles are small and sharply angular. This layer is moderately compact and contains ferruginous pellets ranging from one-sixteenth to one-eighth inch in diameter. The lower part of the layer has a more or less columnar breakage and contains some silica-coated lime nodules and gypsum crystals.

C. 50 inches +, bluish-gray partly decomposed calcareous and gypsiferous shale.

In studies made of the Summit soils under different moisture and cultural conditions and at different places, some interesting features were noticed that were not in the profile described. Cultivation tends to give the soil a lighter gray color, owing to the loss of organic matter, and a heavier texture results on account of the topsoil cracking and the organic part washing into the cracks, which gives the solum in excavations a latticelike appearance. Calcium carbonate nodules occur at irregular intervals, and in these places the material is a little darker and not so thoroughly weathered.

Soils of the third group include members of the Labette and Newtonia series. These soils have dark-brown or red friable silty sur-

face soils and reddish-brown friable silty clay loam subsoils. They show laterization, as they are high in iron and alumina. They are closely associated with the Summit soils.

In a pit just east of Excelsior School located at the southwest corner of sec. 30, T. 29 S., R. 20 E., an area of Newtonia silt loam shows the following profile:

A_1. 0 to 3 inches, dark grayish-brown faintly granular silt loam. The granules are very soft and crumblike. The soil material is uniformly dark brown.

A_2. 3 to 12 inches, dark reddish-brown softly granular silt loam, in which the granules are larger and the dark organic coatings are much thinner than in the A_1 horizon.

B_1. 12 to 36 inches, dark-red silty clay which on crushing becomes brick red and has a greasy feel. Organic matter occurs only along cracks and root channels or in cavities formed by insects.

B_2. 36 to 45 inches, light reddish-brown silty clay loam with a faintly cubical structure, which contains soft ferruginous pellets. This horizon is streaked with yellow and reddish brown. The organic matter is not pronounced.

C. 45 inches, dull yellowish-red clay containing some cherty limestone.

In adjoining cultivated fields Newtonia silt loam appears red, as the organic matter is lacking.

Labette silt loam differs from Newtonia silt loam in having a darker, thicker, and more granular surface layer. The organic coatings around the granules are much thicker, and the material in the lower horizons is heavier and shows some mottlings of yellow and rust brown.

The fourth group includes soils of the Bates series. These soils closely resemble one another in all characteristics except in texture of the surface soil and depth of weathering. In the vicinity of Thayer and south and east of Chanute are areas of the Bates soils. The following description of Bates loam is of a profile examined in a pit one-half mile east of the northwest corner of sec. 25, T. 29 S., R. 17 E.:

A_1. 0 to 3 inches, dark grayish-brown loam forming a porous mulch.

A_2. 3 to 7 inches, dark grayish-brown porous imperfectly granular loam which shows evidence of worm action. The color is almost uniform, but crushed granules are a little lighter.

A_3. 7 to 14 inches, dark grayish-brown loam slightly lighter than the material in the layer above. It is very faintly granular, the granules seemingly being caused by worm action.

B_1. 14 to 30 inches, light rust-brown sandy clay loam containing small cube-shaped particles, the centers of which appear to be lighter rust brown and the outer layers reddish brown, with yellowish-gray material between the particles. The colors, however, are so blended and granulation is so imperfectly developed that color distribution cannot be determined accurately. The material crushes yellowish brown, indicating that the rust shades predominate.

B_2. 30 to 40 inches, moderately compact coarsely granular yellowish-brown clay loam. The insides of the structure particles are red, and the outsides are thickly coated with grayish brown. The material contains sufficient clay to smear between the fingers. When crushed it is mottled red, gray, and brown, the gray and brown colors predominating.

B_3. 40 to 60 inches, gray and rust-brown silty clay containing soft black and rust-brown pellets. This layer grades into the raw unweathered very fine sandy shale.

In the fifth group are the alluvial soils including members of the Verdigris and Osage series. These soils occur along the larger stream bottoms. Following is a description of Verdigris silty clay

loam as observed in a pit 50 yards north of the southeast corner of sec. 6, T. 29 S., R. 20 E.:

(1) 0 to 4 inches, dark-brown granular or semilaminated silty clay loam.
(2) 4 to 14 inches, dark-brown softly granular silty clay loam.
(3) 14 to 30 inches, brown silty clay loam containing streaks, specks, and splotches of gray and rust-brown stains.
(4) 30 to 50 inches+, light yellowish-brown silty clay showing iron stains and some segregated calcium carbonate. This layer gradually merges with the somewhat more water-logged stratified material.

SUMMARY

Neosho County is in southeastern Kansas. It contains 576 square miles, or 368,640 acres. Physiographically, it is part of a slightly dissected plain. The greater part of the land is flat or undulating, with a few low winding ridges.

In 1930 the urban population numbered 10,277 and the rural 12,388. Nearly all the people are of native-white parentage. Chanute is the largest town.

The climate is characterized by wide seasonal variations. The greater part of the annual rainfall occurs during the growing season. Hot winds in late summer may damage growing crops.

Corn, wheat, oats, flax, sorghums, alfalfa, and prairie hay are the principal crops grown.

More than 70 percent of the land is tillable. The soils have been placed in five groups according to common characteritsics and crop adaptations as follows: (1) Cherokee, Parsons, and Woodson soils; (2) Summit soils; (3) Labette and Newtonia soils; (4) Bates soils; and (5) alluvial soils.

The soils in group 1 have light-colored surface soils and dense heavy claypan subsoils which retard internal drainage and prevent the penetration of plant roots to the moisture below. For this and climatic reasons these soils are better suited to short-rooted crops, as wheat, flax, and sorghums. Corn is grown to some extent, but yields are uncertain. The ability of the sorghums to withstand drought makes them more successful. Cherokee silt loam occurs on nearly flat areas and is the least productive of these soils. Woodson silt loam and Parsons silt loam have darker surface soils and contain more organic matter. These soils are not so flat as the Cherokee soil and are better drained.

The soils of group 2 have dark-colored surface layers, rich in organic matter, and moderately heavy subsoils. Such deep-rooted crops as corn produce well on these soils. Wheat and other grains do well, but the need of corn is so great that the greater part of the Summit soils is planted to this crop.

The soils of the third group have dark-brown or red surface layers and reddish-brown silty clay subsoils. These soils are well drained and are cropped to corn, wheat, alfalfa, sorghums, and flax.

The soils of the fourth group have grayish-brown sandy surface soils and yellowish-gray sandy clay subsoils. The physical condition is good and the chemical condition poor. Corn and grain sorghums are the main cultivated crops, and prairie hay is common. Special crops and truck crops are grown on the soils of this group more than on the soils of any other group.

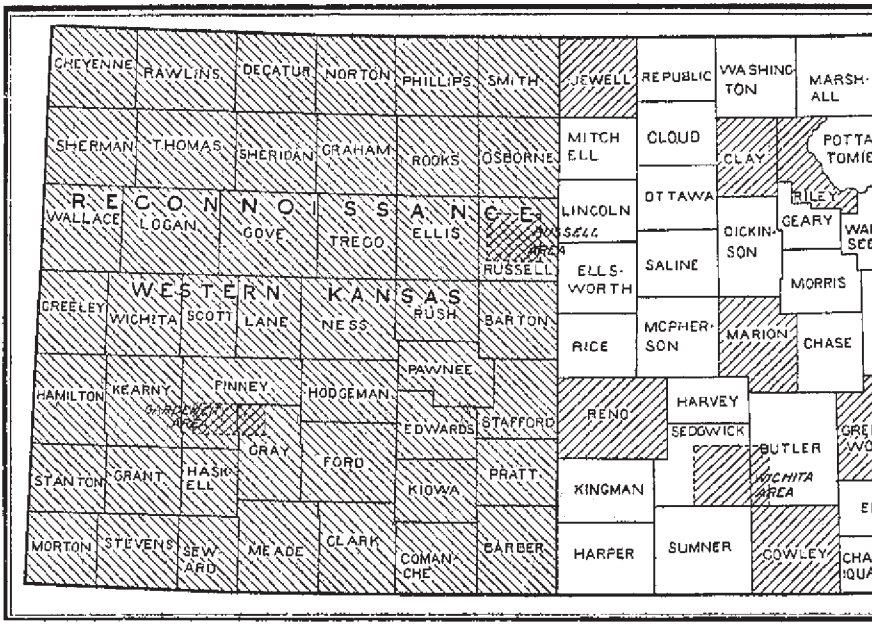
The soils of the fifth group, or alluvial soils, are the most productive soils of the county, but crop harvest is very uncertain on account of overflows. Alfalfa, corn, wheat, clover, and oats are the chief crops.

Fertilizers are in common use, principally on wheat and alfalfa. They are used principally on soils of the first and fourth groups, and to some extent on those of the third group. Fertilizers high in phosphates give the best results. Liming and inoculation are necessary for the successful growing of alfalfa.

○

Authority for printing soil survey reports in this form is carried in the Appropriation Act for the Department of Agriculture for the fiscal year ending June 30, 1933 (47 U. S. Stat., p. 612), as follows:

There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than 250 copies shall be for the use of each Senator from the State and not more than 1,000 copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.



Areas surveyed in Kansas, shown by shading. Detailed surveys shown by northeast-
sance surveys shown by northwest-southeast hatching; crosshatching indicates areas

U. S. GOVERNMENT PRINTING OFFICE: 1938

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SOIL MAP
NEOSHO COUNTY
KANSAS

KANSAS AGRICULTURAL EXPERIMENT STATION
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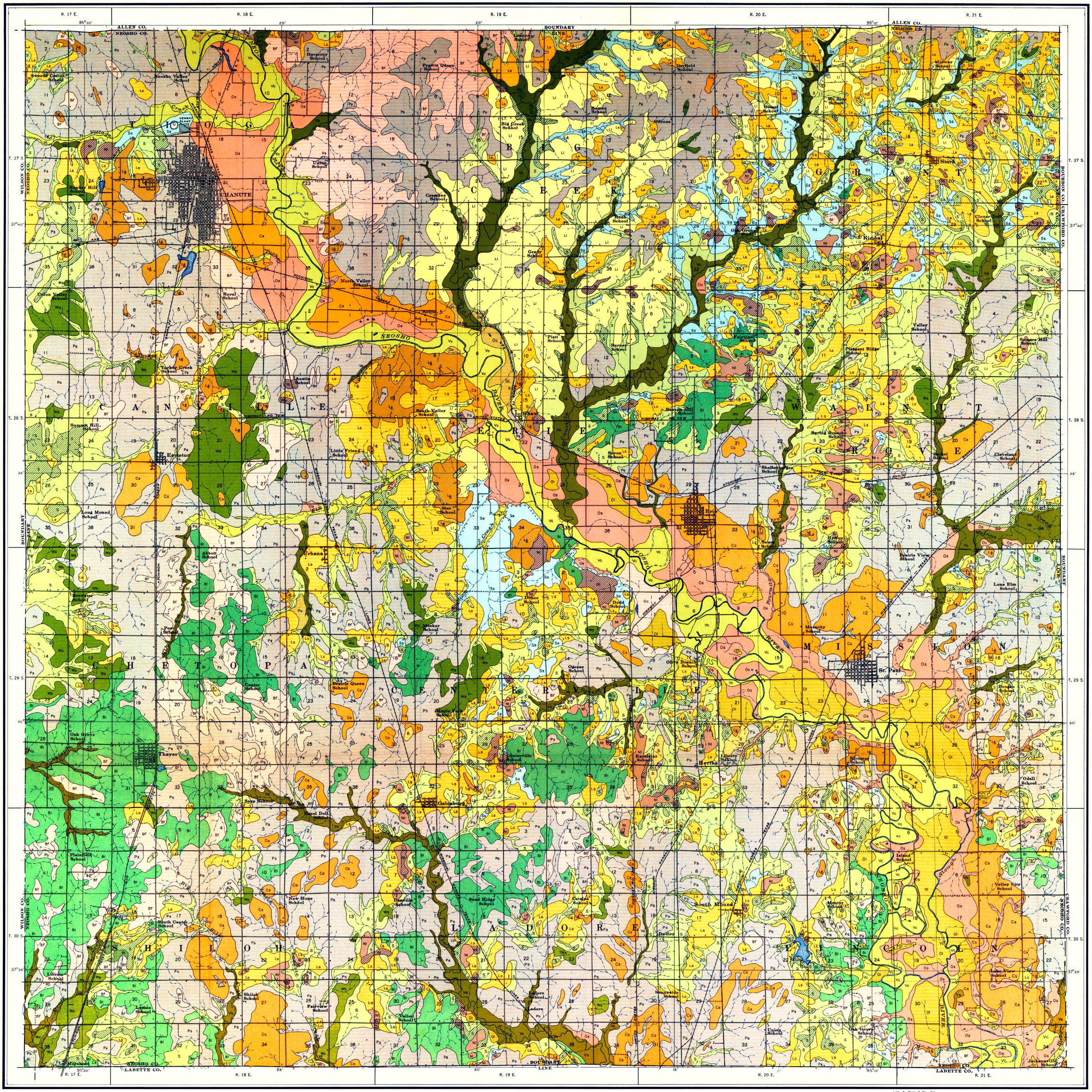

LEGEND

- Bates very fine sandy loam (Bf)
- Osage clay loam (Ol)
- Bates shale loam (B)
- Osage silty clay loam (Os)
- Bates loam (Bl)
- Osage clay (Oc)
- Cherokee silt loam (Cs)
- Parsons silt loam (Ps)
- Labette cherty silt loam (Ll)
- Summit silty clay loam (S)
- Labette gravelly silt loam (Lg)
- S — Shallow phase
- Labette silt loam (Ls)
- Summit stony silty clay (Ss)
- Newtonia silt loam (Nl)
- Verdigris silt loam (Vs)
- Nl — Shallow phase
- Verdigris silty clay loam (Vc)
- Woodson silt loam (Ws)

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

- City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort.
- Secondary roads and Trails
- Railroads Steam and Electric
- Bridges, Ferry
- R.R. crossings, Tunnel
- Ford, Dam
- School or Church Cemeteries
- Mine or Quarry Mine dumps Made land.
- Bluff, Escarpment Rock outcrop and Triangulation station
- Stony and Gravelly areas
- Soil boundaries
- Boundary lines
- Boundary lines
- Boundary lines
- U.S. township and section lines

RELIEF
(Printed in brown or black)

- Contours Depression contours
- Prominent Hills Mountain Peaks
- Sand, Wash, and Sand dunes
- Shore and Low-water line, Sandbar

DRAINAGE
(Printed in blue)

- Streams
- Lakes, Ponds, Intermittent lakes
- Intermittent streams
- Springs, Canals and Ditches, Flumes
- Swamp, Salt marshes
- Submerged marsh, Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

Thomas D. Rice, Inspector, District 3.
Soils surveyed by M. H. Layton, U. S. Department of Agriculture, in charge, and R. W. O'Hara and C. E. Dornberger, Kansas Agricultural Experiment Station.

1 ½ 0 1 2 3 4 Miles
Scale 1 inch = 1 mile

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Field Operations
Bureau of Chemistry and Soils
1930